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10/541207
JC20 Rec'd PCT/PTO 01 JUL 2005
[10191/4226]

DEVICE FOR CLASSIFYING AT LEAST ONE OBJECT WITH THE AID OF AN ENVIRONMENTAL SENSOR SYSTEM

Background Information

The present invention starts out from a device for classifying at least one object with the aid of an environmental sensor system according to the definition of species in the independent claim.

A camera-based precrash detection system is known from DE 100 25 678 A1. In this context, collision counterparts are classified with the intention of providing reliable standardization. The classification is carried out on the basis of the relative velocity of these objects.

Summary of the Invention

The device of the present invention for classifying at least one object, having features of the independent claim, has the advantage over the related art that the object is now classified on the basis of its velocity and the acceleration.

In particular, the acceleration information also allows objects to be classified more reliably. For example, a first discriminating criterion is the exclusion of objects securely anchored to the ground, such as poles and walls, when the object to be classified can be assigned a velocity other than zero. If desired, the position of the object (e.g. on the roadway, next to the roadway) may be used to check the plausibility of the classification. Different classes of objects (such as, on one hand, vehicles and, on the other hand, pedestrians) may also be distinguished on the basis of their movement patterns, i.e. the specific velocity and acceleration characteristic.

It is at least possible to divide the objects into static and moving or accelerating objects. When assigning a crash object to the class of moving objects, this classification may be used for controlling restraint systems in a more precise manner.

Advantageous improvements of the device, indicated in the independent claim, for classifying at least one object are rendered possible by the measures and further refinements specified in the dependent claims.

It is particularly advantageous that the acceleration of the object is determined as a function of the reference acceleration of the observer. However, the acceleration may also or additionally be determined from the time characteristic of the reference velocity and the object velocity. In this context, the reference velocity means the velocity of the observer, i.e. that of the reference vehicle which is equipped with the classification device. This reference velocity may be determined, for example, on the basis of wheel velocities, the ABS system, or the tachometer. The object velocity is the velocity of the object. As an alternative, the velocity may also be determined on the basis of a curve of location information versus time.

In addition to or instead of a radar, ultrasonic, and/or video sensor system, the environmental sensor system may also have a photonic mixer device and/or a LIDAR system, where, in addition to the conventional radar system that uses microwaves, the LIDAR system uses laser.

The environmental sensor system may advantageously have a photonic mixer device, as well. In this context, the so-called time-of-flight measurement is used, which allows distance information in the image plane of an imaging system.

At this point, reference is made to DE 197 04 496 A1, which describes such a photonic mixer device.

As a function of the classification, the driver may also be informed when, for example, a critical situation involving a high accident risk is present. This information may occur optically, acoustically, and/or haptically. In particular, the tightening of the reversible seatbelt tensioner is used as haptic information.

Finally, it is also advantageous that a restraint system is controlled as a function of this classification. This is particularly advantageous for the control of reversible restraining devices, as well.

Brief Description of the Drawing

Exemplary embodiments, of the present invention are shown in the drawing and are explained in detail in the following description.

Figure 1 shows a typical scene of a vehicle and an object, and Figure 2 shows a block diagram of the device according to the present invention.

Description

With the aid of suitable sensor technology, such as radar, ultrasonic, LIDAR, or video technology, it is possible to measure distances and relative velocities between objects and the radar sensor. In this connection, such information regarding the impact time and velocity may be ascertained in precrash systems, in order to control restraining devices.

In certain measuring systems, such as the radar system, which only use the distance information and do not provide three-dimensional spatial resolution, it is not possible to classify

objects, since, for example, only the total radar cross-section is available as a property characteristic of the object.

According to the present invention, an object is now classified on the basis of its velocity characteristic. This means that the characteristic curve of the velocity is determined from the velocity of the object and its acceleration. Both parameters, the velocity and the acceleration, define the object, which means that restraining devices may then be precisely controlled as a function of the classification.

The measuring system determines the relative velocity between the crash object and the reference vehicle. The velocity of the object may be calculated from this relative velocity and the available velocity of the reference vehicle, which may be evaluated, e.g. via CAN. Then, the acceleration of the object may also be estimated from the history of the two data and the brake condition of the reference vehicle. Using the velocity and the acceleration of the object, a classification is undertaken by an object-classification algorithm. If an object belongs to the class of moving and accelerating objects, this information may be used in the algorithm for controlling restraint systems, since it is highly probable that the object is not a pole or a rigid wall. The restraint systems may then be controlled in the algorithm in accordance with the object class and further crash parameters, e.g. acceleration signals and the relative velocity.

Figure 1 shows such a scene, in which the device of the present invention is used. Reference vehicle 10 has a reference velocity VE, while an object 11, a vehicle monitored by the precrash sensor system of vehicle 10, has velocity VO. Relative velocity VR results from the vectorial subtraction of

reference velocity VE and velocity VO. Velocity VR may be ascertained by a precrash sensor system. The accelerating behavior of vehicle 11 may be determined, for example, from the time characteristic of relative velocity VR. Velocity VO, which is determined using relative velocity VR and reference velocity VE, and the acceleration of vehicle 11, result in a classification of vehicle 11. Reference velocity VE is ascertained, for example, via the wheel velocities.

Figure 2 clarifies the device of the present invention, using a block diagram. In block 21, relative velocity VR is ascertained by a precrash sensor system. In block 20, reference velocity VE is determined as shown above, e.g. using the wheel velocities and/or a tachometer. A classification algorithm 22, which is computed on a processor of the control unit, e.g. the airbag control unit, determines the object velocity and its acceleration from the time characteristic of velocities VR and VE. Algorithm 22 classifies vehicle 11 from these velocities and the acceleration. It then assigns, to object 11, predefined object classes which are defined by velocity VO and the acceleration. In block 26, the restraining devices are triggered as a function of relative velocity 25 and further crash parameters, such as the decelerations that are generated in block 24. In this case, the restraining devices may be, e.g. restraining devices R1 a seat-belt tensioner 27, R2 a front airbag 28, and RN a front-passenger-side airbag 29.

Figure 3 explains, in an additional block diagram, the individual components of the device according to the present invention. A precrash sensor system 30 determines relative velocity VR of object 11. In processor 31, which receives the signal of precrash sensor system 30, velocity VO of object 11 is then determined from the signal, using the reference velocity of the vehicle on which precrash sensor system 30 is

located. Reference velocity VE is ascertained, e.g. using a wheel-velocity measurement or the tachometer. This information is contained, for example, on the CAN bus. The acceleration behavior of object 11 is determined from the time characteristic of velocity VO and velocity VE. The object classification is obtained from this, i.e. the class of the object is determined by the acceleration and velocity VO. This object class is then transmitted to a control unit 34 for restraint systems. As a function of the object class and these further parameters, control unit 34, which is connected to other vehicle components and sensors via connections not shown here, determines the activation of restraining devices 35, which include airbags, seat-belt tensioners, and roll bars.